ARPA-E CARBON PRODUCTS PANEL

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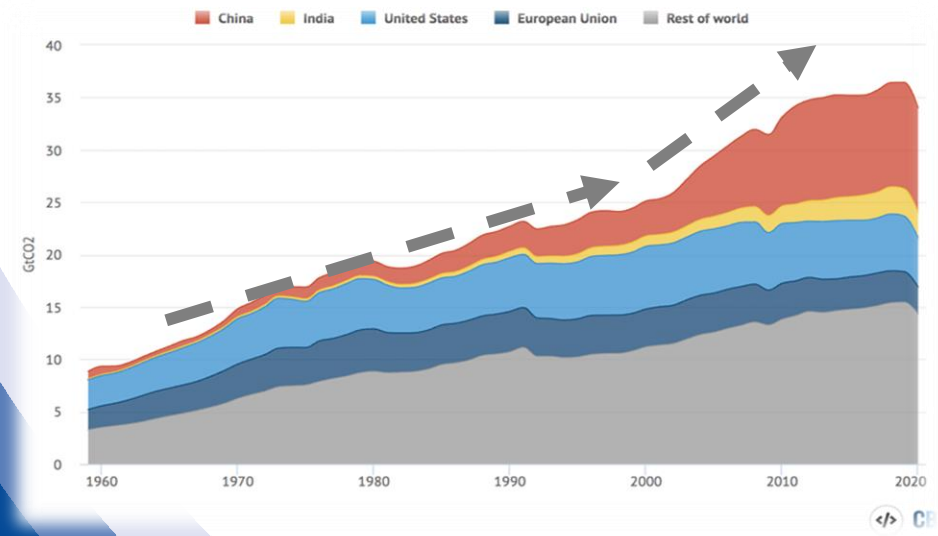
CO_2 Emissions Reduction Rush..

Global CO2 emissions from fossil fuels by region (1959-2020)



Reactions

- Increased **public opinion** awareness
- **Stakeholder and shareholder** push
- **Governments** to address climate change
- **Companies** focus on sustainable growth

Cop 26

- **Secure global net zero** and keep **1.5 degrees** within reach
- Accelerate the **transition from coal to clean power.**
- **Encourage investment in renewables**
- **Protect and restore nature** for the benefit of people and climate

Energy transition

- **European Green Deal** (€1000 mld)
- **Biden's plan** in US ($1200 mld)

Significant Efforts Underway..

Shift to Renewable sources

From fossil energy generation to **wind and solar, renewable sources**

Offshore Wind Farm capacity **from 7GWh** in 2018 **to over 200 GWh** by 2030 (G. Sachs)

Hydrogen

Integrate renewable sources with the **utilization of Hydrogen**

Hydrogen play a part in the future energy make-up: **production of electricity** and as **alternative to fossil fuels**

Hydrogen is already widely **used in some industries**

Emissions Reduction Technology

Development of **CO2 Capture** technologies

New **efficient energy storage solutions**

Circular Economy

Power Cables

Higher is the required current, higher will be the cross-section of the conductor (or performance)
Higher is the required voltage, higher will be the insulation thickness (or performance)

Building Wire

Solar Cable

Offshore Wind Cable

Onshore Wind Cable

Automotive Cable

Fire Resistant Cable

HVDC Submarine Cable

HVDC Land Cable

Crane Cable

Overhead Conductor

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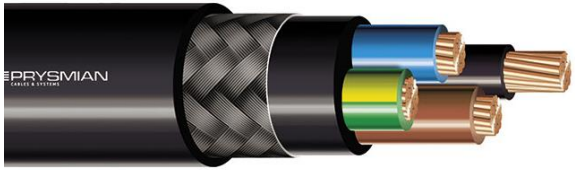
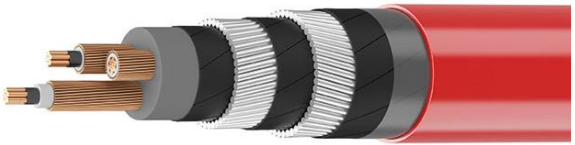
Application needs, Design & Materials

Application Needs and Environment Constraints



- Temperature
- Mechanical Stresses (Static - Dynamic)
  - Bending
  - Pulling
  - Torsion
- Chemical Inertia
- Fire performances
- EMC
- Electrical stresses
- …

Design and Materials Solutions



- Materials
- Design of elements and materials
  - Fine wires conductors
  - Lay length
  - Armoring
- Sheathing materials
- Metallic protections
- Special materials
- Screens design
- Insulation materials
- …

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Benefits of enhanced conductor material

Material	Conductivity (MS/m)	Density (g/cm³)	Specific Conductivity (kS·cm²/g)
Aluminum (=61,5% IACS)	37,7	2,7	140
Copper (=100% IACS)	58	8,9	65
Carbon Nanotube Yarn	7	1,3	54

Lower Weight	• Transportation (Automotive, Aerospace, Ships, Trains) • Floating systems (Offshore windfarms)
Higher Power	• Transmission Lines (Land, Submarine, Overhead) • Distribution networks
Lower Losses	• Long connections, Interconnectors • Infrastructure (Smart Buildings)

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ENERGY TRANSITION ACCELERATION

525kV HVDC technology **interconnectors**

Sustainable: 100% recyclable, -40% CO_2

Higher performance

Faster operations

P-Laser

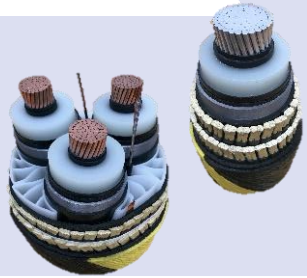
SOO GREEN HVDC link

German Corridors

*ENTSOE estimate interconnector pipeline expected to lead to **30B$** of HVDC orders from 2020 to 2027*

High-depth submarine designs **offshore windfarms**

World's 1st high modulus synthetic armored cable to enable installation **depths up to 3000 m**



Leonardo da Vinci

New US Plant

*IEA estimate **1,4T$** to be invested in Offshore Wind from 2020 to 2040, implying **275B$** in cabling in the same period*

Picture: dellvale

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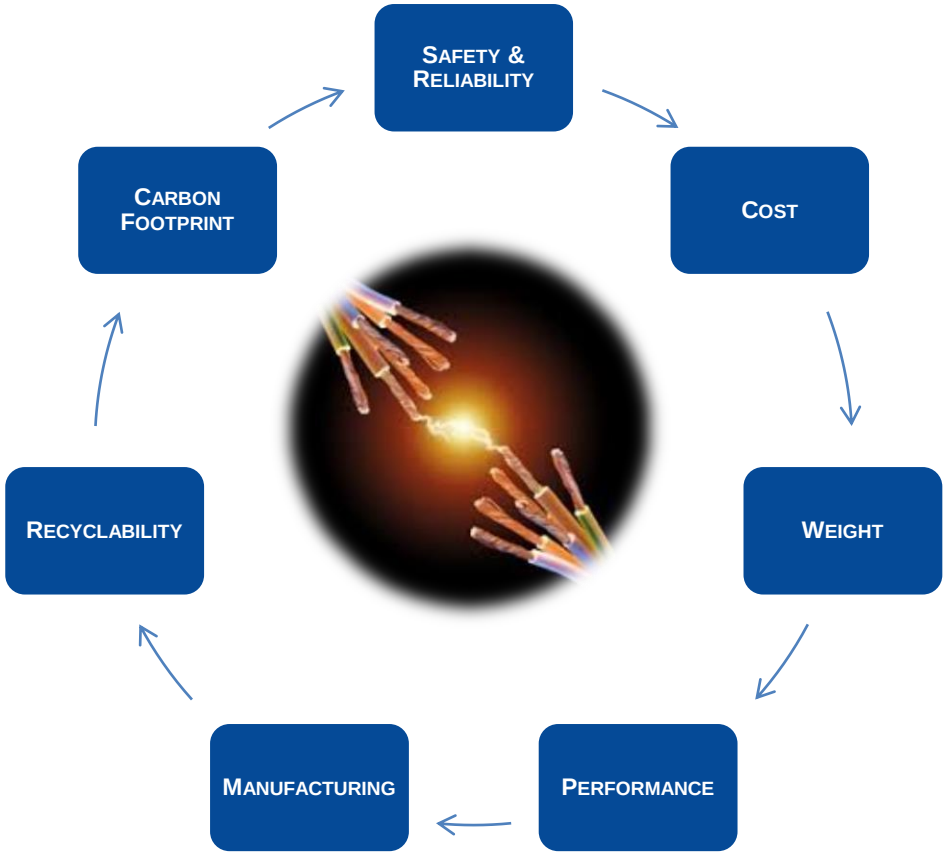
KEY CONSIDERATIONS



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